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Applicant:	Jun Yoshida, et al.
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SUBMISSION OF PRIOR ART UNDER 37 CFR 1.501

Commissioner for Patents
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Sir:

The assignee of the entire, right, title and interest, Makino Milling Machine Co., LTD, Tokyo, Japan, hereby cites and submits the below identified prior art, for filing in the above-referenced patent file under 37 CFR §1.501

This prior art was first learned of, during the prosecution of a parallel application pending before the Japan Patent Office (JPO), as being prior art cited in an Office Action issued on or about February 5, 2008 by the JPO. Said prior art was forwarded by assignee's Japanese patent counsel to U.S. patent counsel, and was received in the United States after the issue date of the above-referenced U.S. patent.

Said prior art submitted herewith:

1) Japanese patent application Publication Number JP2001277073. dated 9 October 2001 - Tool Position Correcting Method for Machining Device - :

2) English translation of the Abstract of JP2001277073;

3) Japanese patent application Publication Number JP2001105278, dated 17 April 2001 - Blade Edge Position Matching Method for Former-Used Tool and Later-Used Tool of Machine Tool - ; and

4) English translation of the Abstract of JP2001105278.

Abstract of JP2001277073:

The reference teaches a tool position correction method in which the actual position of the tool is successively sampled during a machining process (on-the-fly) and position errors, i.e., displacement differences, are measured. The time period between sampling is varied as a function of whether measured position errors exceed a predetermined threshold value.

Between measurements, the displacement of the tool is estimated based upon the prior displacement difference (position error) of the tool at the previous measurement, and the position of the tool is gradually corrected based upon this estimated difference during that time period. The reference for correction is the previous measurement position.

The time interval between successive measurements is gradually increased as long as the position error is less than the predetermined threshold value. Once the position error exceeds the allowable error, the further time are begun to be set shorter than the previous on until the position error threshold is no longer exceeded.

Abstract of JP 2001105278:

The reference teaches a method for correctly positioning the "tip" of a replacement cutting tool, installed to replace the existing cutting tool in the middle of a cutting job, in order to correctly position the new tool to match the position of the "tip" of the old tool being replaced. A position detector is installed at a reference point ("A") to measure the difference between the theoretical and actual positions (position error) of the old tool "tip" at the time before it began cutting the work piece and at the time it is to be changed-over (replaced - after cutting the work piece).

When a new tool replaces the old tool, the cutting machine spindle is moved to the reference point ("A") and the difference between theoretical and actual position of the "tip" of the

new tool (position error) is measured. These three values (old tool "before cutting" and "after cutting" position errors, and new tool "before cutting" position error) are used by a computer program to reposition the machine spindle to more exactly "match" the new tool "tip" before cutting actual position to the old tool "tip" after cutting position, upon tool replacement.

U.S. Patent 7,331,739:

The claimed invention differs from the prior art in how (or when) it measures position differences; and in respect to what reference (point) position differences are measured.

The first reference, JP20012777073, is a method concerned with correcting tool position during a cutting operation. It is conducted while the cutting operation is in progress. The method is conducted by successively measuring tool position during a cutting operation and comparing measured tool position to theoretical tool position to provide a correction. This method encounters implicit errors present with "on-the-fly" measurement, wherein tool movement during a measurement affects accuracy, and wherein calculations and subsequent correction values must time-lag tool movement and therefore carry an inherent error. Furthermore, the point of reference for a given measurement is the previous position measurement which becomes the value against which the new "difference" is determined.

The second reference, JP2001105278, is not concerned with correcting tool position during a cutting operation. It does not address tool position at any time except at tool "change-out". This second reference is concerned with accurately positioning a replacement tool to resume a cutting operation, when the cutting operation has been interrupted to replace a worn tool with a new tool. This method relies upon three factors, the old tool starting position (or theoretical position error), the old tool finishing position (or theoretical position error) and the new tool starting position (or theoretical position error), to calculate an adjustment factor for the machine spindle in order to accurately place the (new) replacement tool "tip" at the exact location vacated by the old tool "tip".

Like the first reference, and unlike the second reference, the claimed invention is concerned with accurately positioning a cutting tool during a cutting operation. Unlike the second reference, the claimed invention is not concerned with adjusting the position of a replacement tool at "change-out".

However, the claimed invention departs and differs from the prior art in at least the following two significant factors.

1) The normal cutting operation is successively and sequentially interrupted (stopped) during normal cutting. During each momentary stoppage, tool wear is detected and tool edge position is corrected for the restart of the cutting operation by the same tool.

2) During each stoppage, wear amount is accumulated as a difference between detected wear (actual wear) and estimated wear (predicted wear). This accumulated wear amount is used in calculating the restart position of the interrupted cutting tool.

Unlike the prior art, in the present invention the point of reference for each position correction is the original (starting) tool position, with wear being calculated as function of an accumulation of the individual successive measurements. The claimed invention accumulates wear amount and uses accumulated wear amounts in position correction calculation. This provides more accurate correction calculations than the methods of the prior art which depend upon measurements of additional wear from the last measurement.

The advantage this feature provides the claimed invention, over the prior art, is that any incidental errors in any one or more of the successive (or sequential) measurements are "averaged-out", i.e., become a part of the accumulation base and are averaged into the accumulation. With the claimed invention, errors in an individual wear measurement do not introduce an error which then becomes significant to successive (future) position correction iterations. With the prior art, an error in one position measurement introduces an error in the

successive measurement as that measurement becomes the reference point for the next measurement.

The references submitted herewith form a part of the published prior art but do not impact the scope of the issued claims.

No additional fees are believed to be required. In the event that an additional fee is required with respect to this communication, the Commissioner is hereby authorized to charge any additional fees, or credit any overpayment, to Paul & Paul Deposit Account No. 16-0750. (order no. 6295)

Respectfully submitted,
Paul & Paul

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